

Pacific Northwest was west of Rooster Rock State Park and at Dalton Point, Multnomah County, OR, and at Home Valley, Skamania County, WA, by Jolley (Wildflowers of the Columbia Gorge, 1988). He called it *A. occidentalis* Abrams. These plants have been identified as *A. fruticosa* by the authors. Additional collections from along the Snake and Columbia Rivers have been made by the authors between 1989 and 1991.

In its native geographic range, *A. fruticosa* occurs along streams, on rocky banks, in open wet woods, on pond shores, in ravines, and along roadsides (R. L. McGregor, *Amorpha* in Great Plains Association, Flora of the Great Plains, 1986). In Oregon and Washington the species occurs in the upper fluctuation zone of run-of-the-river reservoirs along the Columbia and Snake Rivers and the upper drawdown zone of storage reservoirs elsewhere. It also occurs along the banks of some smaller streams. The usual substrates are rock, including riprap, and sand. The species is found along an elevational gradient from 647 meters MSL in Malheur County, OR, to 6 meters in Wahkiakum County, WA. Its common associates west of the Cascade Range are *Rubus* spp., *Salix* spp., *Phalaris arundinacea* L., and *Alnus* sp. East of the Cascade Range, it is commonly associated with *Artemisia* spp., *Centaurea* spp., *Lepidium latifolia* L., *Phalaris arundinacea*, *Salix* spp., *Dipsacus sylvestris* L., *Rumex* spp., *Bromus tectorum* L. and *Sisymbrium* sp.

The source of this invasion by *A. fruticosa* cannot be determined with accuracy. The most likely seed source is along the Boise River in Idaho, where the species may have been planted by the CCC in the 1930's. It is possible that the species may have been introduced more than once.

Amorpha fruticosa occurs in dense thickets along the Snake and Columbia rivers from the Boise Valley to Hood River County, OR. From Hood River westward, its abundance seems to decrease, so that thickets are uncommon but individual shrubs are frequently seen. This distribution indicates an upstream seed source. The relative scarcity of the species west of the Cascade Range may indicate that it is not well adapted to the area. Individual plants seem as robust as those to the eastward, however, so the more likely explanation is that the initial introduction occurred to the east and the plants are spreading to the west slowly. In time perhaps the rivers' edge will support a dense thicket of shrubs all the way to the Pacific Ocean.

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EVIDENCE OF MULTIPLE INTRODUCTION OF *CRUPINA VULGARIS* IN INFESTATIONS IN THE WESTERN UNITED STATES.—Michèle Couderc-LeVaillant, Laboratoire de Biologie, Végétale, Muséum National d'Histoire Naturelle, 61, rue de Buffon 75005, Paris, France and Cindy Talbott Roché, Department of Natural Resource Sciences, Washington State University, Pullman, WA 99164-6410.

An invasion pattern characterized by disconnected, widely separated populations of *Crupina vulgaris* Pers. (Asteraceae: Cynareae) in the western United States emphasizes the importance of investigating the origin of infestations. Following its detection in Idaho in 1968 (Stickney, Madroño 21:402, 1972), *Crupina vulgaris* was found in Santa Rosa, California, in 1975 (Davis and Sherman, Madroño 38:296, 1991); Chelan County, Washington, in 1984 (Environmental assessment for exotic vegetation management in the Upper Lake Chelan Basin, USDA Forest Service, 1991); Umatilla County, Oregon, in 1987; again in Sonoma County, California, in 1989 and in Modoc County, California, in 1991 (D. Barbe, California Department of Food and Agriculture, personal communication). To date all reports have been of a single taxon, which concurs with the hypothesis of a single introduction. However, Patterson and Mortensen (Weed Science 33:333-339, 1985) doubted that the Cali-

fornia infestation could have come from the first detected introduction in Idaho and suggested a detailed taxonomic study of the introduced *Crupina* populations to determine their origin.

This suggestion is valid, but the studies must be based on knowledge of *Crupina* in the Eastern Hemisphere where it is native. Fortunately, extensive taxonomic, cytogenetic and biological studies have been conducted on the three taxa within the genus *Crupina* (Couderc, Origine hybride du *Crupina intermedia* Briq. et Cavill., Colloques internationaux du CNRS, La flore du bassin méditerranéen: essai de systématique no. 234, 531–536, 1974). This note reports the preliminary results of a collaboration which relates the *Crupina* populations introduced in North America with native populations in the Old World.

Achenes from four North American populations of *Crupina*, including Sonoma County, California; Harpster Grade, Idaho County, Idaho; Umatilla County, Oregon; and Chelan County, Washington, were examined to determine their taxonomic status. Among the five varieties of *Crupina vulgaris* cited in the literature, only two varieties are relevant to this study, the varieties *typica* Beauv. and *brachypappa* Beauv. These two varieties are easily and indisputably distinguished by the achenes (Couderc-LeVaillant, L'amphiploïdie dans le genre *Crupina* Dc., Essai de systématique synthétique, Thèse Docteur es Sciences, Univ. Paris-Sud, Orsay, 1984). Achenes of the two varieties differ in middle length of the achene and pappus. In *C. vulgaris* var. *typica*, the length of the achene varies from 4 to 5 mm and the length of the longest pappus silk ranges from 7 to 8 mm, depending on the origin (European populations). In *C. vulgaris* var. *brachypappa*, variation in the same characters is 3.5 to 5.0 mm and 4 to 5 mm, respectively (European populations). Although differences in pappus length provide a clearer differentiation, mean achene length also distinguishes between the two varieties, even if the range of values overlap. These size differences are not influenced by biotype or by environmental conditions as demonstrated by experimental culture.

Achenes from the Idaho population in 1991 varied in length from 3.75 to 5.0 mm; $n = 27$, the 95% confidence interval (C.I. 0.95) was 4.52 ± 0.13 mm. The length of the pappus silk varied from 7.0 to 9.0 mm (C.I. 0.95, 7.98 ± 0.19 mm). These values identify the Idaho population as *C. vulgaris* var. *typica*. Achenes from California and Oregon were within the same range, indicating that these populations are also variety *typica*.

Measurements of the same characteristics on achenes from the Washington population were significantly different. Achene length varied from 4.0 to 5.0 mm (C.I. 0.95, 4.16 ± 0.10 mm). The longest pappus silk varied from 4.50 to 6.0 mm (C.I. 0.95, 5.14 ± 0.11 mm). These measurements placed the Washington population in variety *brachypappa*.

By finding *Crupina vulgaris* var. *typica* in California, Idaho and Oregon and var. *brachypappa* in Washington, we have shown that *Crupina* invaded North America by multiple introduction, with at least two distinct origins.

In Europe the natural populations are generally isolated and homogeneous, but hybridization between the two varieties is possible. According to Briquet (Carpologie du genre *Crupina*, Candollea 4:241–278, 1930), var. *brachypappa* occurs only in the high valley of Durance in France. However, this does not indicate that Durance is the source of the Washington population because later work has established that variety *brachypappa* is much more widespread, occurring in other locations in France, as well as Switzerland, Spain, Greece and Romania (Couderc-LeVaillant 1984).

The fact that *Crupina* was introduced as multiple introductions underscores the importance of a comprehensive taxonomic study of North American populations in relation to Mediterranean sources of introduction. As a federal noxious weed, it is prohibited to import *Crupina* into the United States or to move it across state lines. However, not only the source, but the means of the introductions to this continent remain unknown. The addition of the remaining two species of *Crupina*, *C. crupinastrum* and *C. intermedia*, could substantially worsen the invasion problem. *Crupina*

intermedia is a stable amphiploid resulting from the crossing of *C. vulgaris* with *C. crupinastrum*. With its hybrid vigor, *C. intermedia* is larger and more competitive than either of its parents, with whom it does not hybridize. It has demonstrated its aggressiveness by replacing the parent species and expanding its range in parts of the Mediterranean region (H. Couderc, R. Gorenflot, M. Couderc, and J. Moret, Variation chromosomique d'Angiospermes et Collections Vivantes, Jardins botaniques et Arboretums de demain, Bureau des Ressources Génétiques, 155–165, 1991).

In addition to its practical value, the study of origins and characteristics of *Crupina* in North America by comparing it to native Mediterranean populations provides insight into the behavior of invading species.

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NEW COMBINATIONS IN *RHAMNUS* (RHAMNACEAE). — John O. Sawyer, Jr., Department of Biological Sciences, Humboldt State University, Arcata, CA 95521.

Rhamnaceae in the forthcoming revision of Jepson's Manual of the Flowering Plants of California will have the following taxonomic changes based on study of specimens in the field and at CAS, HSC, JEPS, RSA, and UC.

In his 1938 monograph, (Monographs of the Rancho Santa Ana Botanical Garden, Botany Series 1) C. B. Wolf recognized six subspecies in *Rhamnus californica* Eschsch. Two have leaf blades \pm glabrous on the lower side (*R. c. ssp. californica*, *R. c. ssp. occidentalis*) and four have leaf blades tomentose on the lower side (*R. c. ssp. crassifolia*, *R. c. ssp. cuspidata*, *R. c. ssp. tomentella*, *R. c. ssp. ursina*). Because I consider *R. tomentella* Benth. as distinct from *R. californica* the following new combinations are necessary:

Rhamnus tomentella Benth. ssp. *crassifolia* (Jepson) J. O. Sawyer, comb. nov. Based on *R. californica* Eschsch. var. *crassifolia* Jepson, Man. Fl. Pl. Calif., p. 615. 1925. Ridge west of Bear Valley, western Colusa Co., *W. L. Jepson 8974*. Synonyms: *R. californica* Eschsch. ssp. *crassifolia* (Jepson) C. B. Wolf, Mon. Rancho Santa Ana Gard. Bot. Ser. 1:68. 1938.

Rhamnus tomentella Benth. ssp. *cuspidata* (E. Greene) J. O. Sawyer, comb. nov. Based on *R. cuspidata* E. Greene, Leafl. Bot. Obs. & Crit. 1:64. 1904. Near Tehachapi, Kern Co., Calif., n. d., E. I. Greene, June 22, 1889. Synonyms: *R. californica* Eschsch. var. *viridula* Jepson, Man. Fl. Pl. Calif., p. 615. 1925 [as *virida*]. Cottonwood Creek, 7500', *W. L. Jepson 5086*, *R. californica* Eschsch. ssp. *cuspidata* (Benth.) C. B. Wolf, Mon. Rancho Santa Ana Gard. Bot. Ser. 1:72. 1938.

Rhamnus tomentella Benth. ssp. *tomentella*. Pl. Hartw. 303. 1848. The Sierra Nevada foothills, collected by Hartweg. Synonyms: *R. californica* Eschsch. var. *tomentella* (Benth.) Brew. & Wats., Cal. Calif. 1:101. 1876. *R. californica* Eschsch. ssp. *tomentella* (Benth.) C. B. Wolf, Mon. Rancho Santa Ana Gard. Bot. Ser. 1:70. 1938.

Rhamnus tomentella Benth. ssp. *ursina* (E. Greene) J. O. Sawyer, comb. nov. Based on *R. ursina* E. Greene, Leafl. Bot. Obs. & Crit. 1:63. 1904. On Bear Mt. near Silver City, New Mexico, O. B. Metcalfe 172. Synonyms: *R. californica* Eschsch. ssp. *ursina* (E. Greene) C. B. Wolf, Mon. Rancho Santa Ana Gard Bot. Ser. 1:74. 1938.

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